NASA SBIR/STTR Technologies

A1.07-9813 - Variable Fidelity AeroPropulsoServoElasticity Analysis Tool

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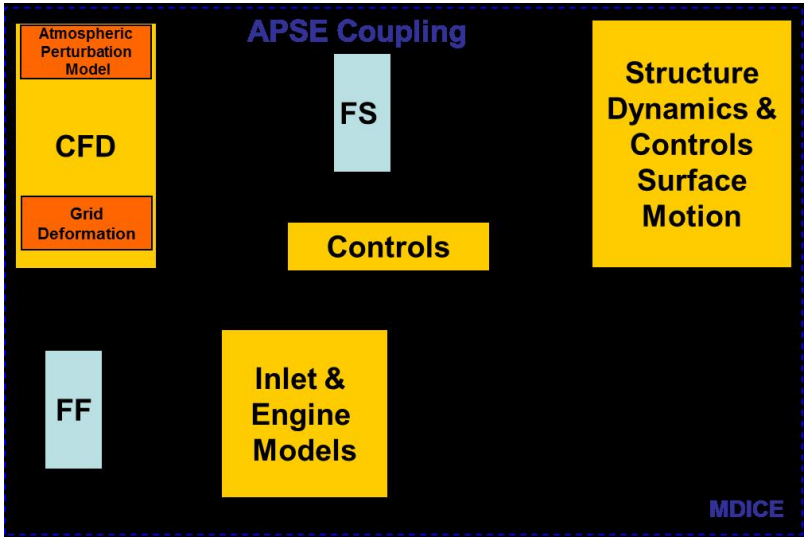
Identification and Significance of Innovation

The dynamic response of next generation flexible, slender supersonic aircraft is characterized by the interaction between the nonlinear aerodynamics, propulsion, control system, and structural dynamics. These AeroPropulsoServoElastic (APSE) phenomena can negatively impact ride quality, engine performance and flight control. Optimizing the performance, safety and durability demands a thorough understanding of the APSE phenomena. CFDRC proposes to develop a coupled multi-physics framework for variable fidelity APSE simulations of supersonic vehicles. The proposed effort will leverage a previously developed AeroServoThermoElastic framework. The computational framework will be enhanced with newly developed non-intrusive codes integration methodology. Additional code for the propulsion inlet and engine controls systems will be integrated with the computational framework to create an APSE analysis tool for next generation supersonic commercial aircraft simulations.

Estimated TRL at beginning and end of contract: (Begin: 2 End: 3)



Technical Objectives and Work Plan

Technical objectives are to develop, validate, and demonstrate a variable-fidelity multi-physics framework for high order accuracy AeroPropulsoServoElastic (APSE) simulations of supersonic aircraft. An existing AeroServoThermoElastic (ASTE) framework will be leveraged for this work. The specific work plan for the Phase I includes:

1.Implementation of an improved, non-intrusive fluid structure interface within NASA's FUN3D CFD solver.
2.Integration of engine and inlet models into the APSE framework.
3.Development of adequate supersonic transport aircraft configuration CFD and FEM models for software demonstration
4.Demonstration of the full capabilities of the APSE framework on an supersonic transport aircraft configuration.

NASA Applications

NASA applications include supersonic and hypersonic vehicles and aircraft (e.g. X-51), inflatable aerodynamic decelerators, and the Commercial Orbital Transportation Services (COTS) vehicles. The APSE framework will lead to improved performance and safety and significantly reduce the dependence on flight and wind tunnel testing, thereby reducing the time required for development and certification of new commercial aircraft and spacecraft.

Non-NASA Applications

Non-NASA applications include design and development of hypersonic vehicle programs for DARPA (Tactical Boost Glide, X-51), Air Force (X-51), U.S. Navy (CPGS, Rail Gun) and U.S. Army (Advanced Hypersonic weapon). Supersonic programs applications include Next Generation aircraft as well as future high speed Unmanned Aerial vehicles.

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